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ABSTRACT

The process of conducting a task analysis is one of determining exactly and in greatest detail what people do when they perform a certain job, or what they need to know when they enter a certain course of study. A task analysis is sometimes, but not always, preceded by a needs assessment to identify discrepancies between training or educational programs or courses that exist and programs or courses that ought to exist. Task analyses are conducted so that instructionally important tasks may be identified, instructional time conserved, and costs kept to a minimum. Also provided from task analysis is a list of behaviors from which student centered instructional objectives may be derived. This paper describes task analysis in six sections: (1) what task analysis is; (2) why conduct task analysis; (3) where task analyses are conducted; (4) when to conduct a task analysis; (5) who conducts task analyses; and (6) how they are conducted. Information is provided on listing identified tasks, creating a detailed description of what needs to be done, and constructing a task analysis work sheet. (JD)

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THE WHAT, WHY, WHERE, WHEN, WHO AND HOW OF BEHAVIORAL TASK ANALYSIS

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INTRODUCTION

I use as a point of departure in this writing, the Apriori assumption that there are two classes of educators. There are those who act as resources, approaching the teaching-learning process based upon the proposition that they are the best learning resource or repository of knowledge, more appropriate than either text books or workbooks. Mager and Beach (1967) call the second type of educator, a manager, or one who manages the learning resources and the learning environment. Those of this persuasion plan, organize and control learning materials and the learning environment while they lead and guide their students as they attempt to facilitate the greatest amount of learning gain possible. This second group of educators are the ones for whom this paper is written. The purpose of this paper is to provide, for them, a well rounded overview of the task analysis process.

The paper is divided into six sections: (1) What; (2) Why; (3) Where; (4) When; (5) Who; and (6) How. In the What section, task analysis is defined. This is followed by a discussion of why such an analysis is conducted. Then, we consider where it is conducted. When a task analysis is conducted, follows, after which, who conducts the analysis is considered. Finally, the How section provides a stepwise treatment of how one would actually go about conducting a task analysis.

WHAT

What exactly is a behavioral task analysis? Yaney (1974) defines such analysis as the systematic definition and classification of tasks, subtasks, job elements, working conditions and standards for the purpose of improving human performance through instructional technology and man power development. Gagne (1974) considers task analysis to be the identification and classification of learning outcomes. Like Yaney (1974), Herschbach (1979) describes task analysis as a procedure used to identify job tasks and determine the instructional importance of those tasks so that there will be a high degree of efficacy between instruction and how well students perform following the instruction. Task analysis was described by Cunningham (1971) as being closely associated with the specification of tasks or activities it is hoped students will be able to perform once they have successfully completed a lesson or educational product. In his operational definition, Davies (1974) calls task analysis twin processes of description and prediction:

> Task analysis is concerned with gathering a particular range of interrelated information in order to allocate priorities and make optimal decisions about the design of learning environments for a set of performance objectives. Thus, the ultimate aim of task analysis is to describe a task in terms of its underlying plan in such a way that it is possible to make predictions about the design which are most likely to bring about the required levels of human performance and acheivement.

This definition is supported by Heiss (1977) who states that instructional planning and evaluation of the outcomes of instructional planning are directly related to the degree learners and learning activities are matched and that task analysis is a way of displaying diagnostic information so that sound matches may be made. According to Lerner (1976), task analysis:

> ...is a method that is used to provide further diagnostic information; it is an approach to evaluation designed to lead to appropriate teaching. Two ways to think about task analysis are... (1) the modality-processing approach ...(2) the skills-sequence approach...the first analyzes the child, while the second analyzes the content to be learned.

Educational Resources Information Center (ERIC) (1983) defines task analysis as the process of identifying all things that individuals must accomplish to satisfactorily complete an activity or a course of instruction.

Many similarities exist between the task analysis definition (Yaney, 1974; Gagne, 1974; Herschbach, 1979; Cunningham, 1971; Davies, 1973; Heiss, 1977; Lerner, 1976; ERIC 1983). Task analysis is a process used to identify major tasks and subtasks of each major task which must be performed in order to accomplish something. Two examples of task analyses are provided in Figures 1 and 2.

Major Task No.	Sub-Task No.	Subsub-Task No.	Task Sub-Task Subsub-Task
1.0			Sound Alarm
	1.1		Break Glass
		1.1.1	Grasp Hammer
		1.1.2	Rap Glass Panel
		1.1.3	Beware of Flying Glass
	1.2		Push Button
		1.2.1	Insert Finger
		1.2.2	Push Button All the Way In
		1.2.3	Use 5 lbs. Pressure
		1.2.4	Maintain Pressure For 5 Seconds

Figure 1. Breakdown of Sounding Fire Alarm Task

In Figure 1, the major task, sound alarm, has been divided into two sub-tasks: (1) break glass; and, (2) push button. For each of the sub-tasks, several subtasks have been identified.

The major task, Maintain Dental Health, listed in Figure 2, has seven sub-tasks. In this case, however, subsub-tasks have not been identified for the subtasks

Major Task No.	Sub-Task No.	Task Sub-Task
1.0		Maintain Dental Health
	1.1	Identify Plaque
	1.2	Floss Daily
	1.3	Ingest Flouride
	1.4	Visit Dentist Regularly
	1.5	Eat Proper Foods
	1.6	Brush After Each Meal
	1.7	Avoid Eating Between Meals

Figure 2. Breakdown of Maintaining Dental Health

If we are to understand what task analysis really is, to synthesize a paradigm useful to teacher managers, we must first understand what task analysis is not. While task analysis is a process, it is not the process of determining what people cannot do or do not know, that's behavior analysis (Zemke, 1977). Behavior analysis is often used when researchers attempt to ascertain the relative success of a training or educational program. Further, task analysis is not the process of determining instructional objectives (Herschbach, 1979). Development of instructional objectives is a linking step between task analysis information and learning outcomes. Objectives, therefore, are structured directly from task analysis information translating it

into behaviors students should manifest as a result of completing a training or educational program.

There is sometimes one anticedent step in the curriculum development process, conducted prior to the task analysis. That step is a needs assessment. Needs assessments usually identify discrepencies between what training or educational programs or courses do exist and what programs or courses ought to exist. In other words, needs assessment is the first step taken when developing a new course or program. The genesis of assessments usually lies in obvious inconsistencies between how people can perform or what they know and how they need to perform or need to know. Needs assessment, thus, may be the first step taken to eradicate the training or educational void.

As is implied above, however, a needs assessment is not always conducted. This is the case, for example, when trainers and educators attempt to adjust courses and programs to correspond with student needs. Here, courses and programs have already been established and it is simply a matter of insuring that what is taught best serves enrollers.

A great number of task analysis schemes have been suggested by Annett and Duncan (1967). They were classified broadly by Davies (1973) into six different categories based upon the character of the underlying assumptions they make. Those categories are: (1) task analysis based upon objectives; (2) task analysis based upon behavioral analysis; (3) task analysis based upon information processing; (4) task analysis based upon a decision paradigm; (5) task analysis based upon subject matter structure; (6) task analysis based upon vocational schemata.

The process of conducting a task analysis then, regardless of its classification, is one of determining exactly and in greatest detail what people do when they perform a certain job, what they need to know when they enter a certain course of study and so on.

WHY

Why are task analyses conducted? Herschbach (1977) suggests task analysts are conducted because all subject matter is not of equal instructional importance; some must be learned to a high degree of mastery because performance levels are critical. Extended formal instructional time must be spent on these tasks while others require minimal classroom time. In addition, only salient matters should be included in formal instruction because of limited available time. Task analysis provides a way to identify need-to-know versus nice-to-know tasks, task redundancy and relative levels of task importance.

Task analyses are conducted, therefore, so that instructionally important tasks may be identified, instructional time may be conserved, instructional costs may be kept at a minimum and as is eluded to here and mentioned specifically in the What section, to provide a list of behaviors from which student centered instructional objectives may be derived.

WHERE

Where are task analyses conducted? They are conducted in offices, conference rooms, work spaces, libraries; in short, anywhere that yields job, course, training program and educational program related task information. This statement becomes much more vivid when we get to the How section; libraries, however, are not discussed there.

What can be found in a library germaine to task analyses? It matters not whether an analysis is conducted for a job, course or program, dictionaries, encyclopedias, periodicals and texts contain a wealth of information regarding tasks and task relevancy for almost any area one can name. A researcher, interested in designing an educational program to train chemistry laboratory researchers might consult, among other sources, the Journal of Chemical Education to identify tasks.

WHEN

A task analysis is conducted whenever there is a need. A need exists whenever: (1) a discrepency exists between job requirements and available training programs; (2) a discrepency exists between job requirements and the skills possessed by people graduating from training programs, the express purpose of which is to train people for that job; (3) new courses of study are proposed by school administrators; (4) new educational programs are proposed by school administrators; (5) educational programs are unable to meet the needs of students or society.

WHO

Who conducts task analyses? The answer to this question is far from simple and depends to a large extent upon how a task analysis is conducted, when it is conducted, where it is conducted, and why it is conducted.

Traditionally, task analyses have been conducted by training managers, curriculum supervisors and others in school, industrial and training environments charged with administering the acquisition and maintenance of adequate levels of human performance. These are the managers who, based upon inputs from such quarters as needs analysis, societal philosophy and the like, manipulate the directions taken by education and training programs.

Publishers like Ginn and Company, who write multilevel textbook series also conduct task analyses.

The largest group of individuals who conduct task analyses, however, are classroom teachers, college professors and vocational trainers. This group of people, while they normally do not consider themselves as plotting or determining the directions curricula take, although they don't realize it, in part conduct a task analysis each time they set out to change courses, develop new courses, or education and training programs based upon some observed needs.

HOW

The literature is replete with methods which may be used to conduct task analyses (Schlenker, in press). The method described here has been synthesized from Mager and Beach (1967), USN Chief of Education and Training (1967) and Commandant of the Coast Guard (in press). It has been used as a curriculum development tool at Maine Maritime Academy, Castine, Maine. The process consists of three major phases: (1) task listing; (2) task detailing; and, (3) task analysis work sheet construction.

1. Task Listing. The first step in the process is called Task Listing. Here, the investigator (the one conducting the analysis) poses one major question; what tasks should competent people be able to perform. These tasks may be cognitive, psychomotor, affective, or any combination thereof. It is a simple listing process regardless of whether it concerns jobs, educational programs, training programs or individual courses.

Task Listing employs a Task Listing Sheet (see Figure 3).

TASK LISTING SHEET

Job/Course/Program _____

Task No.	TASK DESCRIPTION	PERFORMANCE FREQUENCY	DIFFICULTY

Figure 3. blank Task Listing Sheet

The format of the form is not especially important. The one shown here includes four columns. The Task Number column is used to number tasks sequentially from one to the end. The numbers are not related to the importance of the tasks, only the order in which they are listed. Task 1 is the first task listed, task 2 the second, and so on.

The Task Description column includes simple descriptions of tasks. An electronics technician (job) might be expected to repair electronic equipment, a person who graduates from a civil engineering technician AAS degree program to survey land plots, a person graduating from a milwright apprenticeship program to operate a surface grinder and a person successfully completing an introductory chemisty course to calculate motarity or know how to apply quantum theory to determine the location of electrons around the nuclei of atoms.

The frequency of performance column is quantitative. The listing indicates how often the task is performed. Any meaningful descriptor may be used here; constantly, four times a day, daily, weekly, monthly, seldom and so on.

The Difficulty column uses a numbering system to indicate relative difficulty. If, for example, 1 is a very difficult task to perform, then 5 might be a very easy task. Other tasks would fall somewhere between 1 and 5.

There are several steps to the task listing phase. First, the person charged with conducting a task analysis lists all the tasks he thinks a competent person in a particular area should be able to perform. If we are dealing with a job, the next step is to seek the

aid and wisdom of others knowledgeable about the job.

The researcher may consult job supervisors and people working at the particular job. Supervisors are asked to list tasks they think people who can fill the job (based upon job description) should be able to do if they are considered competent.

Another step is to consult people who are actually performing the job. They too are asked to list tasks they must perform during the course of a normal work cycle.

Once these steps are completed, the researcher becomes an observer. Much like a time study expert, he watches and records, listing the tasks our competent worker actually performs.

The process to this point has generated four separate lists of tasks which now must be colated (see Figure 4).

Job/Course_____		
Step No.	Source of Task Information	Recorder
1	Thoughts of Researcher	Researcher
2	Thoughts of Supervisor	Supervisor
3	Thoughts of Worker	Worker
4	Observations of Researcher	Researcher

Figure 4. Sources of Task Information

At this point, all lists are combined to form a master list. The master list is then circulated to both supervisors and workers alike who make final comments regarding the inclusion of tasks or conversely, their elimination. Then the investigator synthesizes the final list of tasks the competent job holder should be able to perform (see Figure 5).

TASK LISTING SHEET

Job Radio Operator

Task No.	Task Description	Performance Frequency	Difficulty
1	Knows Phonetic Alphabet	Constantly	3
2	Operates Telegraph Key	Constantly	2
3	Drafts Messages	Daily	4
4	Types Messages	Daily	1
5	Performs Equipment Maintenance	Weekly	1

Figure 5. Partial list of Radio Operator Competencies

Several different considerations are made when a task analysis is conducted for an educational course. As was discussed above, the first thing one does is to list all of the tasks a person should be able to do if he or she successfully completes a course. In this case, the researcher must know what and/or how students will apply their terminal behaviors. If, for example, introductory chemistry is a prerequisite for organic chemistry, then the researcher must have in his task list, tasks which are considered minimum entry level behaviors for the organic course. In this regard, it is important that entry level behaviors be listed from all courses for which the introductory course is prerequisite.

Researchers must also examine what competent individuals should be able to do upon graduation from an educational program (degree or other). Although introductory chemistry may be the only chemistry course taken during a degree program and it may not be prerequisite for any other course, there still may be chemistry related tasks the competent graduate will be expected to perform. An individual who

graduates from a Merchant Marine Academy, while he or she does not need the skills imparted in introductory chemistry as prerequisites for other courses, must after graduation be able to evaluate the ion content of shipboard engineering plant water if they are marine engineers. Evaluation of marine engineering water ion content is a task, therefore, that program graduates must be able to perform. Thus, it must be listed as a task for the chemistry course.

Other sources of task related course information are instructors who teach similar types of courses, students who have completed a type course and gone on to apply their backgrounds to other courses, institutional course administrators, administrators and instructors involved in more advanced educational programs and societal trends. Those who are listing tasks for high school classes would seek input from a variety of colleges, while people gathering task information for college courses might look to graduate schools for advice.

Another source of task relevant information is the literature. Researchers dealing in the fields of sociology and psychology might include tasks related to current research findings and current trends in society. In addition, they might seek input from professionals practicing in the field of interest.

After all the sources of input have been identified, the process continues essentially the same as that described above.

Task listing for educational and training programs results in a broad list. Here, investigators list all tasks a competent program graduate should be able to perform. Information is gathered from graduates working in a field (same as a job), employers, administrators of and instructors in more advanced programs and so on. Again, the remainder of the process is the same as that previously discussed.

The final task list is converted into terminal performance objectives. While a discussion of the conversion is beyond the scope of the paper, readers should understand that task lists are the sources of course and program objectives. Interested readers should consult Herschbach (1979) for an exceptionally precise treatment of the conversion process. As he points out, the efficacy of any course, educational or training program, is how well a graduate can perform. The linkage therefore between terminal objectives and tasks is of paramount importance.

2. Task Detailing. The process follows Task Listing. It involves the breakdown of tasks listed on the Task Listing Sheet into subsub-tasks (see Figures 1 and 2). Some type of task detailing sheet is normally employed in the process (see Figure 6).

TASK DETAILING SHEET
Job/Course/Program_____
Task _____

No.	Sub-Task Subsub-Task	Type of Learning	Learning Difficulty

Figure 6. blank Task Detailing Sheet.

With task detailing, each task listed on the Task Listing Sheet is broken down on a separate Task Detailing Sheet. The number column

on the Sheet serves the same function as it does on the Task Listing Sheet; it simply represents the sequence in which the sub-task was listed. The Learning Difficulty column also has the same purpose as that described for the identical column of the Task Listing operation. The sub-task and subsub-task column includes each very specific sub-task and subsub-task a competent person must perform if he or she is to be considered competent at performing the task. Subsub-tasks are more specific than sub-tasks; as tasks may include several sub-tasks, so subtasks may include several subsub-tasks. Sub-tasks and subsub-tasks are sometimes called task elements and task sub-elements, (Herschbach, 1979) in which case, the Task Detailing Sheet is probably better titled a Task Element Sheet.

Mager and Beach (1967) identified five types of learning that can be listed in the Type of Learning column. They were discrimination, recall, speech, manipulation, and problem solving.

Figure 7 provides an example of a partially completed task detailing sheet.

TASK DETAILING SHEET
Job/Course/Program Auto Mechanic
Task 1.0 Perform minor engine tuneup

No.	SubTask SubsubTask Subsubtask	Type of Learning	Learning Difficulty
1.1	Prepare work station	Recall	2
1.2	Fill out work order	Recall	3
1.3	Remove air cleaner	Recall	3
1.3.1	Back off wingnut	Discognitive Recall	4
1.3.2	Lift air cleaner off post	Recall	5
1.3.3	Cover Carburetor opening	Recall	5
1.3.4	Wipe air cleaner with cloth	Recall	6
1.3.4.1	Select clean cloth	Discriminate	3
1.3.4.2	Fold in quarters	Recall	6
1.3.4.3	Wipe inside of cleaner	Recall	6

Figure 7. Model Task Detailing Sheet.

Task detailing or identifying the task elements is essential to the same process regardless of whether the task is related to an educational or a training program; regardless of whether the task is psychomotor, affective or cognitive. Sub-tasks eventually become enabling objectives (see Herschbach, 1979).

3. Task Analysis Work Sheet. Completion of the Task Analysis Work Sheet is probably the final step conducted by a task analysis researcher. The Task Analysis Work Sheet provides space to describe how to do each sub-task, why the sub-task is done, and the skills the performer must possess if he or she is to successfully complete the sub-task. A model of the Task Analysis Work Sheet is provided in Figure 8.

TASK ANALYSIS WORK SHEET
Job/Course/Program_____
Task _____

WHAT TO DO	HOW TO DO IT	WHY DO IT	SKILLS REQUIRED
Performs what action? (action, verb & object)	Using what tools, equipment, work aids? Upon what instructions.	To produce or achieve what? Use phrase... in order to...	Ability to do something.

Figure 8. Sample Task Analysis Work Sheet.

What to do? Here we write each sub-task (or task element) exactly as it was written on the Task Detailing Sheet. Subsequently, each sub-sub-task is listed below the sub-task to which it is associated, but first each of the other columns, for the sub-task is completed.

How to do it? Here we write a detailed list of steps required to correctly perform the sub-task. Sometimes investigators find that when they have completed listing the required steps, they have listed all of the subsub-tasks. Although this need not be the case, it often happens and should not be considered a mistake in application of methodology.

Why do it? The question, "Why do it?" is asked for at least two reasons. First, it helps users of the task analysis to see the interrelationships of many of the sub-tasks and subsub-tasks. Second, if an answer cannot be found, then the sub-task need not be performed. Why teach someone a sub-task for which he or she has no use. Why waste valuable instructional time when there scarcely is enough time to teach needed task related elements.

Skills required are skills which must be in the students repository of skills if he or she is to perform the sub-task successfully. Once all of the necessary skills have been listed, the information provided for the task in question must be evaluated.

The evaluation produces one of two conclusions. Either all of the subsub-tasks have been addressed, or they have not. In the case of the former, the next step is to list the next sub-task and proceed as before. If all of the subsub-tasks have not been covered, then the relevant subsub-tasks are listed one at a time and the procedure for the sub-tasks is followed for each (see Figure 9).

TASK ANALYSIS WORK SHEET
Job/Course/Program Advanced Rural Sociology
Task Understands ABC Program

What to do	How to do it	Why do it	Skills Required
1.1 Collects data about current developments in the ABC program	Using items of human interest. Using knowledge of the ABC program	In order to prepare a brief summary for submission to public relations specialists	Be able to describe the ABC program
1.2 Examines information on application form	Using information supplied by applicant and collateral sources	In order to determine if applicant is eligible for ABC program assistance	Be able to list requirements for ABC program eligibility

Figure 9. Completed Task Analysis Work Sheet

Task Analysis Work Sheet information is used when lessons are planned. How to do it and Skills required information is used in the presentation portion of the lesson while Why do it information is extremely important in a lesson introduction, helping greatly to establish for students, the value of a lesson.

CONCLUSION

Task analysis, an extremely important part of the educational and training process, is the link between what competent individuals need to do and what they are taught to do in courses, and training and educational programs. As it is presented here, it consists of three steps. They are: Task Listing; Task Detailing, and completion of the Task Analysis Work Sheet.

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